



Evaluation of non-US Experience: A Pilot Project on ACR

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Background

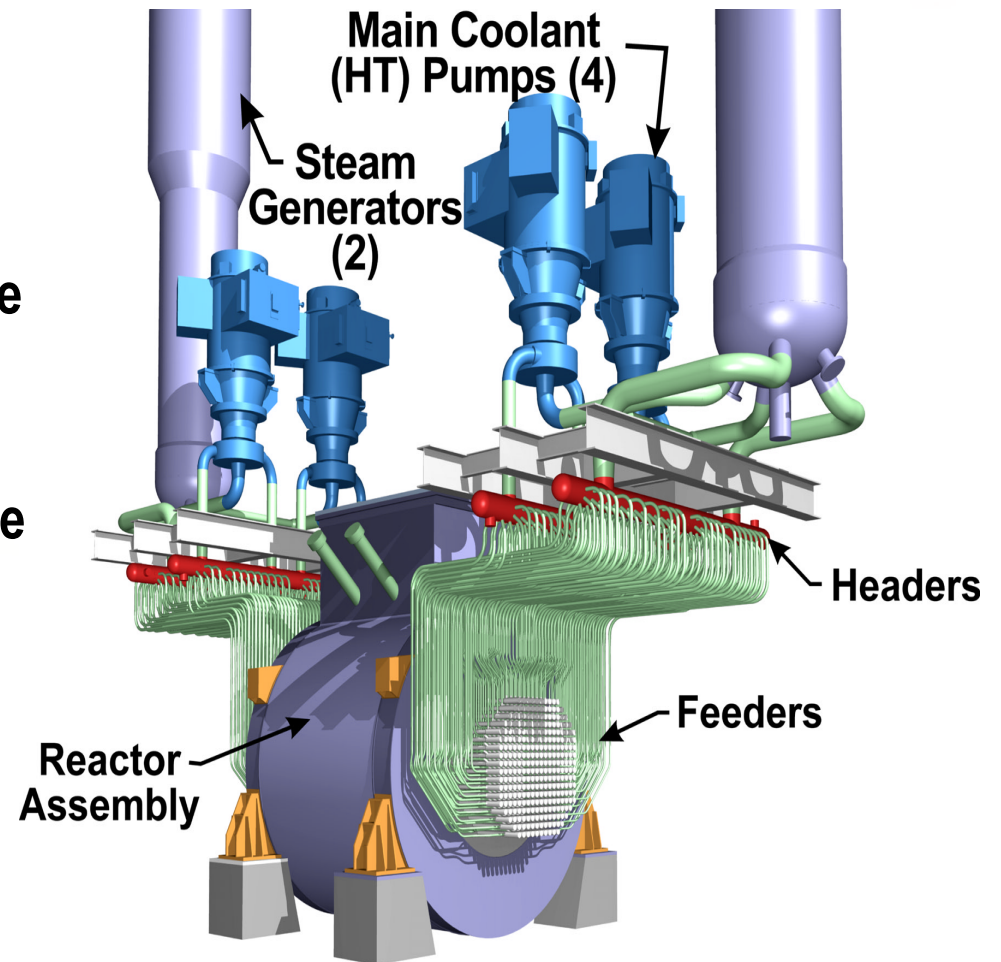
- The ACR-700 is an evolutionary extension of the proven CANDU 6, which has eight units in operation on four continents, two units currently under construction, and one which went critical in September 2002





Design Summary

- Light water coolant
- Slightly enriched fuel
- Heavy water moderator
- Horizontal pressure tubes as the core pressure boundary
- Each channel connects via a small inlet and outlet feeder pipe to headers above the core
- 4 pumps, 2 steam generators above the core
 - similar to PWRs





Maturity

- **CANDU is a mature technology licensed and operating in Canada, Argentina, South Korea, Romania, & China**
- **Supported by ~50 years of R&D**
- **Regulators in these countries have performed independent reviews to determine acceptability**
 - **have used, reviewed and largely applied Canadian experience**
- **ACR represents an evolution, not a revolution**
 - **Most of the CANDU technology base applies**
 - **Modest extensions to code validation envelope + component tests**



ACR Regulatory Status

- **U.S. – pre-application review underway with intent to submit application for Standard Design Certification and/or COL**
- **Canada – pre-licensing review with Canadian Nuclear Safety Commission (CNSC) underway**
- **U.K. – possibility of pre-licensing review by Nuclear Installations Inspectorate (NII) under discussion**
- **Initial three-regulator meeting held to explore co-operation**



Licensing Opportunity

- **AECL recognizes that each regulator is responsible for licensing ACR in its own country**
- **Need some mechanism to use the existing R&D and licensing experience to date so that current licensing reviews make best use of available resources and information**
- **Need to demonstrate flexibility in regulatory approach to non-US technology so US can benefit from its introduction**
- **Need to show that safety intent of the USNRC requirements is met without requiring line-by-line compliance**
- **Result: Enhance effectiveness of US regulatory review**



Pilot Project

- **Pilot project proposed to see how US could use & incorporate non-US experience as a basis for NRC regulatory acceptance**
- **Scope must be complex enough to be a meaningful test, but limited so it can be shown to work in a reasonable time frame**



Specific Proposal

- Like LWR, CANDU has a main-line system thermohydraulics code for transients & accidents (CATHENA)
 - Full two-fluid one-dimensional network transient model
 - Integrated plant controllers
 - Detailed fuel, fuel channel models at high temperature
- Extensively validated against tests in full-scale fuel channels and full-height CANDU system thermohydraulic loops (RD14, RD14M)
- Used in licensing analysis for CANDU 6 in Canada, China, Korea, Romania
- Determine basis for NRC agreement that code and supporting validation is acceptable for use in US licensing of ACR
- Restrict to system thermohydraulics portion for pilot project



Scope

Independent review of the technical thoroughness and completeness of the formal validation process

- **Technical comparison to the validation methods required by the NRC for computer codes used in LWR safety analysis and/or to generally accepted practice**
- **Gap analysis between the CANDU methods and those developed to validate LWR safety analysis codes**
- **Recommendations on how to close significant gaps, if any**
- **Overall: independent judgement as to the technical adequacy of the formal validation & verification of the CATHENA computer code**



Report

- **Independent report would be submitted to the NRC for review and concurrence as part of pre-application review**
- **AECL would commit to the timely completion of the work to address the gaps, identified in the report, that the NRC considers technically significant**
 - **i.e., which would preclude NRC acceptance of the use in the US of the CATHENA computer code for ACR safety analysis**
- **NRC would issue SER on the results of their review**



Independence

- **Propose to use US National Lab. (or NRC-recommended alternative) to perform initial review**
 - **Allows flexibility in interpretation of requirements, use of international experience**
 - **Supports DOE policy of facilitating introduction of non-US technology**
 - **Creates US expertise for use in further CANDU work**
- **NRC, DOE, the US lab. and AECL would discuss the terms of reference for the review to ensure that it is well understood and appropriately focussed prior to the lab commencing the work**



Schedule

- **Estimate about 4 months for report from Lab.**



Next Steps

- **(Verbal) agreement in principle from NRC**
- **AECL to approach DOE plus National Lab or alternative**
- **Finalize terms of reference**
- **Advise ACRS (?)**
- **Start work**

